



NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I

Name of the Programme and Specialization	M.Tech. – Power Electronics		
Course Title	Grid Converters for Renewable Energy Applications		
Course Code	EE698	No. of Credits	03
Course Code of Prerequisite subject(s)	-		
Session	JANUARY 2023	Section (if, applicable)	M.Tech,PE
Name of Faculty	Dr. M Sahoo	Department	EEE
Email	sahoo@nitt.edu	Telephone No.	0431-2503274
Name of Course Coordinator(s) (if, applicable)	-		
Course Type	<input type="checkbox"/> Core course	<input checked="" type="checkbox"/> Elective course	

Syllabus (approved in BoS)

Photovoltaic power development, wind power development, grid converter structures, modeling and control of grid-tied converters. International regulations, response to abnormal grid conditions (voltage deviations, frequency deviations), power quality issues on DC current injection, current harmonics, power factor. Grid requirements for wind turbine systems, grid code evolution, frequency and voltage deviation under normal operation, active and reactive power control in normal operation, behavior under grid disturbance. Grid synchronization with PV and wind turbine systems, voltage vector under normal and abnormal grid conditions, synchronous reference frame PLL under unbalanced and distorted grid conditions, operation of different PLL techniques. Overview of control techniques for grid connected converters under unbalanced grid voltage conditions, control of grid converters under grid faults. control structures for unbalanced current injection, power control under unbalanced grid condition, flexible power control with current limitation.

Reference Books:

1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez., Grid Converters for Photovoltaic and Wind power Systems, first edition, Wiley Publication 2011.
2. Amirnaser Yazdani, Reza Iravani., Voltage Sourced Converters in Power Systems, Modeling, Control and Applications, Wiley Publications 2010.
3. Ned Mohan, Tore M, Undelnad, William P, Robbins (3 Edition), Power Electronics: Converters, Applications and Design; Wiley 2002.
4. BinWu, Yongqiang Lang, Navid Zargari and Samir Kouro., 'Power Conversion and Control of Wind energy systems', John wiley & sons, inc., publication 2011.

COURSE OBJECTIVES

To understand the modelling, controlling of the grid connected converters for PV and wind applications.

COURSE OVERVIEW

Students can understand and analyze various grid connected converter configuration. Can know about the international standards being followed for integrating renewable energy sources to grid. They will understand the various control techniques involved in controlling active power and reactive power fed to the grid under normal as well as unbalanced grid conditions. Further they can explore various PLL techniques involved in this control techniques.



MAPPING OF COs (Course Outcomes) with POs (Programme Outcomes)

Upon completion of the course, the student will be able to

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1: Investigate the converters structure for grid connected PV and wind systems.	2	2	2	3	3	3	2	1	-	-	1	1	-	-
CO2: Understand the grid requirements for PV and wind turbine systems under normal and abnormal grid conditions.	1	2	2	2	3	3	1	1	-	-	1	-	-	-
CO3: Evaluate the various control aspects and techniques for grid connected converters under normal and abnormal grid conditions.	2	2	2	2	3	3	2	1	-	-	1	1	-	-

COURSE TEACHING AND LEARNING ACTIVITIES




S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1 to 2	Course plan details Photovoltaic power development, wind power development, grid converter structures, modeling and control of grid-tied converters.	Chalk & Talk/PPT
2	Week 3 to 4	International regulations, response to abnormal grid conditions (voltage deviations, frequency deviations), power quality issues on DC current injection, current harmonics, power factor.	Chalk & Talk/PPT
3	Week 5 to 6	Grid requirements for wind turbine systems, grid code evolution, frequency and voltage deviation under normal operation	Chalk & Talk/PPT
4	Week 7 to 8	Active and reactive power control in normal operation, behavior under grid disturbance.	Chalk & Talk/PPT
5	Week 9 to 10	Grid synchronization with PV and wind turbine systems, voltage vector under normal and abnormal grid conditions.	Chalk & Talk/PPT
6	Week 11	Synchronous reference frame PLL under unbalanced and distorted grid conditions, operation of different PLL techniques.	Chalk & Talk/PPT
7	Week 12 to 13	Overview of control techniques for grid connected converters under unbalanced grid voltage conditions, control of grid converters under grid faults.	Chalk & Talk/PPT
8	Week 14-15	Control structures for unbalanced current injection, power control under unbalanced grid condition, flexible power control with current limitation.	Chalk & Talk/PPT
16	Week 16	COMPENSATION ASSESSMENT (CPA)	-
17	Week 16/17/18 08.05.2023 to 18.05.2023	Final Assessment	-

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment-1 (CT-1) (Written Test)	Week 7	2hr	20
2	Assessment-2	will be carried out along with the course		20



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	(Assignments)			
3	Assessment-3 (Mini-Project)	will be conducted along with the course		20
CPA	Compensation Assessment	Week 16	2 Hrs	20
4	Final Assessment	Week 17/18	3 Hrs	40
COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed) <ul style="list-style-type: none">• Feedback from the students during class committee meetings• Anonymous feedback through questionnaire (Mid of the semester & End of the semester)• End semester feedback on Course Outcomes				
COURSE POLICY (including compensation assessment to be specified) <ol style="list-style-type: none">1. Attending all the assessments mandatory for every student2. One compensation assessment will be conducted for those students who are being physically absent for the assessment 1 and/or 2, only for the valid reason.3. At any case CPA will not be considered as an improvement test.4. Absolute/Relative grading will be adopted for the course.				
ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed) <ul style="list-style-type: none">➤ At least 75% attendance in each course is mandatory.➤ A maximum of 10% shall be allowed under On Duty (OD) category.➤ Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.				
ACADEMIC DISHONESTY & PLAGIARISM <ul style="list-style-type: none">➤ Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.➤ Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.➤ The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.➤ The above policy against academic dishonesty shall be applicable for all the programmes.				
ADDITIONAL INFORMATION, IF ANY				
FOR APPROVAL				
Course Faculty		CC- Chairperson		HOD  08/02/23



Guidelines

- a) The number of assessments for any theory course shall range from 4 to 6.
- b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.
- c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.
- d) The passing minimum shall be as per the regulations.

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2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

- e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.
- f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.
- g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.